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The Agave : A Plant and its Story

by Jan Kolendo

History

The Agave, which has also been called the 'century plant', the 'Century Aloe' and the 'American Aloe', obtained it's name from the Greek language--- the word 'agavos' meaning illustrious, an apt description for some magnificent and noble plants. The word is found in a number of instances in classical mythology. Agave, the mother of Pentheus, was the deified daughter of the god Cadmus, the mythical founder of the ancient city of Thebes, and his wife Hermione. Her story is told by Euripides in the Bacchae, where the god Dionysius, angry at being rejected as a god by the city of Thebes, which was ruled by Pentheus, throws a spell of drunkenness upon the women of the city, causing them to lose control and revel on the mountainside. Whilst under this spell, Agave and her fellow revellers notice Pentheus spying on them and not recognising her own son , whom she mistakes for a marauding lion in her drunken stupor, she and her companions set upon him in a particularly brutal way and literally tear him apart limb from limb. She does not realise what she had done until she returns to Thebes with the head of Pentheus as her 'prize' and presents this grizzly trophy to Cadmus. She sobers up rapidly when it is pointed out to her that the head is that of her own son and falls into a frenzy of grief. She exiles herself from Thebes and is heard of no more. "....Pentheus was torn in pieces by his own mother Agave, at the head of her companions at the ceremony, as an intruder upon the feminine rites as well as a scoffer at the god"(Grote: Hist. Greece, pt. 1 ,ch. 1). It was also the name of one of the fifty Nereids, a group of sea nymphs,daughters of the ancient sea god Nereus and his wife Doris. They were described as beings with green hair and the lower part of their bodies was fish like i.e. a sort of early punk mermaid.

Throughout the history of the New World the agave has been closely associated with mankind in a multitude of ways, both with the original inhabitants of Mesoamerica and subsequently with invaders and conquerors from Europe. In the pre conquest era the agave was well established as an important feature of everyday life and religion and played an prominent role in the human sacrifice which especially the Aztecs practised to an extent which horrified even Cortez and his soldiers. The native Mexican Indians had a complex religion and a formidable array of gods, most of whom appeared to be very bloodthirsty and

who needed to be sustained and honoured with sacrifices, usually human. They were represented on earth by priests who were at the top of a very rigid class structure and consequently had many priviledges, such as control over land and food distribution, jobs, taxes, and supervision over the allocation and consumption of agave juice. Quetzacoatl, the serpent god, who represented the arts and morality, was the only deity apparently opposed to human sacrifice and paid for his views by being driven out into exile. It was said that his return would coincide with the fall of the Aztec empire. Sacrifice to the god of hunting was preceeded by the shooting of many arrows in a chosen specimen of agave. One of the major sacrificial events in the calender seems to have been the ceremonies in honour of Huitzilopochtli, the god of the sun and of war, who was represented by a hummingbird. These events seem to have been marked by the consumption in large quantities of pulque, an intoxicating, fermented liquid product of the agave. The word Chalchihuatl meaning 'precious liquid' was used to refer to the agave juice. It was known that in order to extract the best quality juice it was necessary to castrate the plant by removing the embryonic reproductive structures or the flowering stalk so that flowers and seeds were not produced. The sugar rich nutrients then ebbed from the leaves and flowed into the heart of the plant and produced a beverage of higher quality. The Aztecs also realised that by castrating these plants they were depriving the pollinating hummingbird Huitzilopochtli of his nourishment and consequently had to make amends by sacrifice. The word Chalchihuatl also came to mean 'nectar fed to the gods' in the sense of human blood. Captives of war (the Aztecs would often wage war specifically to increase their stocks of victims intended for sacrifice) were brought to temples at the top of pyramids where they were given pulque to drink and were dedicated to the god. From that time they were considered as carriers of the nectar belonging to the hummingbird god and they lived peacefully, provided with the best food, elegant clothing and maidens as partners until such time as the god required sustenance. At these times, often in famine or war, the victims were again taken to the temples and were given pulque to consume. This time however the circulating agave juice was offered to Huitzilopochtli by priests, whose enthusiasm for sacrifice was fuelled by also drinking pulque, ripping the heart out of the unfortunate, still living victims. The flesh was then cooked and eaten, cannibalism being practised by the Aztecs on a very wide scale. On a typical sacrificial night it was an legitimate act for all the celebrants participating to carry on drinking the pulque without restriction. During the dedication of the Templo Major to Huitzilopochtli in 1487, 20,000 captives were sacrificed and one can only guess at the amount of pulque consumed and the effect on the local agave populations. Estimates of sacrifices range from 4,000 annually according to the diaries of Cortez to a more recent figure of 250,000 annually (Borah, in Harner 1977). On ordinary days, as opposed to special occasions, drinking was not allowed except by persons,male or female, who had reached the age of 52 plus the sick, pregnant women and nursing mothers, on account of the rich nutritional properties of the juice. The penalties for breaking these laws were severe and involved punishments such as shaving of the hair, flogging or loss of job in minor cases and execution for more severe or repeated incidents.They were apparently frequently and strictly enforced, especially if the law had been broken in a public place.

There was an agave goddess depicted called Mayahuel with 400 nipples symbolising her nutritious power and representing, via the agave plant, the embodiment of fertility. She was a benign deity, related to the gods of wind, rain and crops. Pictographs show the goddess usually emerging from the plant, foaming pulque in her hair and holding pots of pulque plus rope made presumably from agave. It is she who is reputed to have shown to the people the process to extract the sap and produce pulque whilst her husband Petecatl was responsible for the first process of fermentation. There was also a group of Rabbit gods associated with the consumption of pulque.

Contrasting with the widespread cultivation and use of agave crops further south,documented

evidence of the Indians further north i.e. what is now the southwestern part of the U.S.A. shows a much less important role. Cultivation seems to have been limited to much smaller plantings and the agave certainly does not seem to have represented any major role as cultigen. Although there is evidence of use for food and fibre, farming was done on a relatively small scale on valley slopes. Archeological work has discovered evidence of plantations and roasting pits. Charred plant remains found at these sites have been proved to be burnt fragments of agave, showing a consistent association between these sites and agave. Stone artifacts provide additional evidence of plant use e.g. broad flat implements with edges sharpened by chipping and grinding and these so called mescal knives were used by the Indians to sever the leaves prior to roasting. Amongst these charred remains there was very little evidence of flowering or fruiting parts of agaves in keeping with the fact that harvesting is completed before the maturation of the flower stalk and consequent dissipation of stored nutrients. Various parts of plants have been identified by archeologists including leaf fragments, individual fibres and plant bases and further research suggests the presence of Agave parryi and Agave murpheyi. In this particular geographical area of study it would appear that maximum utilisation of the agave occurred in prehistoric times and it's role was not so important to subsequent groups of native inhabitants

Cortez and his Spanish invaders had arrived in agaveland from Cuba in 1519 looking for a new source of gold and other minerals plus a new pool of labour to replace the depleted indigenous population of the Caribbean Islands. He discovered an enchanted new world full of new resources and commercial practices. He mentions the existence of pulque in his first letter to King Carlos V as reported by Zamora: " They sell honey emanated from corn that are as sweet as the sugar obtained from a plant they call maguey and from these plants they make whine and sugar which they sell". During the 16th century Francisco Ximenez, a Spanish monk, wrote about the importance of the huge variety of products obtained from the maguey and in 1651 a Spanish doctor called Jeronimo Hernandez described the medicinal uses of mezcal, reporting that as a cure for rhematism the liquid was to be rubbed into the affected part. Subsequent to the invasion the outward spread of agave cultivation had occured rapidly in all directions from it's original nucleus. Local Indians were used by their new masters in many varied roles, as guides,interpreters, labourers and farmers and as colonisation spread the Spaniards took their labour force with them. The Indians in turn took their agaves with them and so occurred the spread of species to new habitats beyond their natural range. This process went a step further by the Spanish and Portuguese taking agaves abroad for ornamental and economic use and thus these plants found their way to the Azores, Canary Islands, Africa, Asia and Europe. The main species involved appear to have been Agave americana, angustifolia, cantala and lurida.

There is evidence from paintings, murals, frescoes and illustrations that agaves may have been grown in Europe for some 3000 years. There are frescoes depicting succulents illustrating Homer's Odyssey whilst in the oldest church in Denmark, 900 years old, there are frescoes showing cacti and agaves. Columbus collected agaves amongst other species in 1492--93 as he mentions the finding and collection of 'aloes' and there is more recorded evidence in diaries from subsequent voyages. In 1516 Peter Martyr mentions agaves, sedums and sempervivums in 'Decades de Orbe Nova' and the same author in ' De Rebus Oc. et Orbe Novo' published in Basle in 1533 describes amongst the plants of the island of San Domingo "eine Maguei" (a Maguey), a common local term for an agave, which was mistaken for a type of palm. He is thought to be refering to Agave antillarum. The first specific mention of Agave americana is by Lopez de Gomara in 'Historia general de las Indias' (Saragoza 1552). This particular species might have arrived in Europe sometime after 1520 and was mentioned by Charles de L'Ecluse in 1576 who had seen it in a monastery in Valencia and sent offsets to his friend Coudebeq an apothecary in Antwerp.It was de L'Ecluse, better known as Clusius,appointed as the first director of the Leiden Botanical Gardens in Holland in 1590

and the man who brought the tulip to Holland, who first coined the name American Aloe.
In 1535 Gonzalo Hernandez de Oviedo described the agave in his work ' The Natural History of the West Indies'. He wrote ' In the Isle of Hispanola and in Mexico there are types of trees more wild and frightening than you can imagine and, in each case, I could not say if it is a tree or plant because it has huge, thick leaves which grow in all directions. The agave was known to the ancient Mexicans under the name of ' melt ' ,later as ' cardon ' and most recently as ' maguey '. On it's home territory it reaches twice the height of a man and the trunk is the width of a thigh. It has some forty leaves in the shape of a tile, wide with curves, teeth on the margins and ending in a point at the tip of the leaf. There are as many of these plants here as there are vines at home.When planted it produces a stalk bearing flowers and seeds. The trunk is used as wood and the leaves as tiles. It can be used as fuel and the ash is very good for washing. It is cut down before it gets too big and before the trunk becomes too thick. When you make a cavity in the plant a thick syrupy liquid flows out which makes pulque. If you heat this pulque it makes a sort of honey which can be refined into sugar, but if you allow it to degenerate it turns into vinegar. You can add the roots of Ocpathi to this pulque to make a sort of wine drunk by the locals. The heart of the plant and the tender leaves are useful in cooking.
This plant is useful in a number of ways : moist leaves, covered in a linen cloth, can be used as a plaster to put round a limb or an arm broken in several places and in fifteen days it will be united and healed as if it had never been broken. The juice, extracted from lightly cooked leaves, put on an ulcer or fresh wound causes it to heal rapidly. The sap of the flowers and roots mixed to a bitter tasting juice neutralises the effects of a rattle snake bite. From the agave a type of paper used in medecine is made.
With the fibres and the thread you can make sandals, mats, clothes and saddles. The end spines are so strong and sharp that they can be nailed into wood and, if sharp enough, can be used as needles to sew leather and cloth . Finally these spines can also be used in human sacrifice to penetrate the flesh of the victims without breaking or becoming blunt.
What other plant can provide man with so many uses ? '.

The first description of a flowering agave in Europe was in 1561 by Jacob Anton Cortosus of Padua followed by Cesalpino in Pisa in 1583. There followed a list of descriptions of flowering agaves around Europe and it is interesting to find on that list several records of flowering agaves in England, including at Hampton Court in 1714 and an Agave americana at Cliff House in Salcombe in 1774 known to be 28 years old at the time of flowering.
The next significant chronicler of agaves was an English traveller called John Gilton, who visited ' Nova Hispania' between 1568 and 1572 and wrote " About Mexico and other places in Nova Hispania there groweth a certain plant called Magueis which yieldeth wine, vinegar, hony and blacke sugar and the leaves of which dried they make hempe, rope, shooes which they use, and tiles for their houses, and at the end of every leaf there groweth a sharp point like an awle, wherewith they use to bore or pearce thorow anything". In 1596 an Italian translation appeared of the history of the native Indians of Central America by Acosta in which he calls the agave 'the wonderous tree' : " el arbol de las maravillas es el Maguey". By the eighteenth century Agave americana was well established in southern Europe and along the Mediterranean coasts to the extent that in 1730 an Italian writer called Francesco Carli used the term Italian Aloe in refering to agaves growing in the vicinity of Lake Garda. The spread reached it's zenith in the nineteenth century when agaves became very popular throughout Europe as ornamentals in both public and private collections. Whereas in southern Europe cultivation was possible in relatively warm outdoor sites, further north the growth of these plants was hampered by climate and was generally restricted to pots and greenhouses.
Apart from Europe there is evidence of a link between America and Asia as far back as 700

B.C. Agave angustifolia and Agave cantala appear to have been known about in various Asian countries a long time before they were recorded in Europe. Fibre industries were developed by Dutch colonists in the nineteenth century in the far East and in the twentieth in East Africa ,using Agave sisalana, thus ensuring further propagation in these areas.
In it's North American home, as we can see from the evidence, the agave was one of the first and most important factors in the early development of agriculture. The ease with which it can be propagated is no doubt a vital reason. No need for complicated manouvres with seeds, simply pulling up and replanting offsets would almost guarantee a new plant being established in the next year or two. The various tribes developed a close relationship with these plants, which provided them with food, drink, fibre, shelter and various assorted natural products. New methods of culture, harvest and species selection have been developed in different regions, dependant on local conditions and needs.Various uses have ensured that the cultivation of agaves has continued for centuries and has assumed in some areas a vitally important economic role, such as the manufacture of rope and related products and of course Tequila.

The Uses of Agaves

1) Food source

There is good archeological evidence that man has used agave as food for at least 9000 years. Research work by Callen (1965) on mummified human faeces dated by carbon14 techniques showed that between 7000 B.C. and 1500 A.D. agave formed 25--60% of the studied excreta. One should add that these samples were obtained from cave sites and that they represent perhaps a rural as opposed to an urban diet. There is evidence of the use of agaves from discovered specimens of chewed agave fibre, from artefacts made from agave fibre and also tools used in these processes. As man gained more and more experience in the utilisation of these plants he was able to select for his use species which had better yields in terms of fibre, food and drink. As he travelled more widely he took his favoured species with him and these were crossed with new varieties producing new and better specimens. He was then further able to refine the plants for his own uses and becoming gradually more sophisticated he was able to produce plants suited to his specific needs. In the words of Gentry (1982) " even though he had no concept of genetics, he quite innocently fostered an explosive evolution in agave diversification". Even today agave portions are widely on sale in Mexican markets.
The chief source of nourishment is carbohydrate and sugar in the body of the plant and in the bases of the leaves, excluding the green parts, the content and consequent palatability increasing with increased maturity. Recent analysis of agave juice reveals a pH of 5-6 with a calorific value of approx. 300 per 100mls. There is a fructose content of 90-93%, also glucose, other reduced sugars and a minute iron content. Young flowering stems and also the flowers are quite edible and are prepared for eating by roasting or by boiling. There is also good evidence of agaves frequently being eaten raw.
One of the main ways in which agaves were cooked was the so called pit baking. This appears to have been more widespread in the more northerly parts of Mexico and also in in the American southwest. There is not much supportive evidence for this communal method further south.Work by Achmann(1959), who obtained evidence from archeological reports and accounts written by colonial missionaries, suggests that edible agaves were a very important resource for the Indians of California, comprising 28% of their annual food consumption. This figure rose to 45% in springtime when other forms of vegetables were in short supply.
In comparison to territories further south the use of agave for the production of drink here appears to be minimal or non existant and it was primarily employed in the production of food. Miguel del Barco, a Jesuit priest stationed at the Mission San Javier in the Sierra de la Giganta between 1738 and 1768,has written a lengthy account of the history of the region and

describes in some detail the use of agaves by the natives. He clearly states that they knew well that the plants were useless once they had flowered and died and were able to recognise a plant about to flower in order to utilise it. They used special hardwood tools with beveled ends to cut both the trunks and the actual bodies (called mezcales) of plants, removing especially the upper parts of the body (called the head of the mezcal or cabeza), this being the most tender,thick and juicy portion and the best for eating. Having beheaded the mezcal they also removed the leaves. He went on to give an excellent account of pit baking , which has also been fully described by Castetter et al. (1938). Pit baking tended to be a family or community orientated ritual. Tasks were separated into the gathering of wood and making the fire by the females ,whilst the males tended to concentrate on the actual harvesting of the plants and building of the pits. These were dug in the ground and lined with stones. When the baking was about to begin, the plant parts were placed in the pits often on a layer of leaves or grass. there was also a covering layer of similar material or earth in order to keep the heat in. The cooking process took generally one or two days and then the plants were ready either to be eaten then or to be stored to be eaten cold later. The process often meant that the plants were cooked on the outside but still raw within. Agave leaves, as might be expected, are rich in fibre content and parts of the leaves were discarded post chewing , thus leaving archeologists with material to research on. It was also clear that not every type of agave was suitable for eating as some were quite unpalatable and some positively totally inedible so selection was made as time went on of the most suitable species. Agave palmeri and agave parryi have been identified as species used whilst there is also evidence of the use of the flowers of agave desertii.
In the Tehuacan area of Mexico agave flowers (agave bovicornuta and agave stricta) have been noted to to have been boiled and then scrambled with eggs. The Indians of Oaxaca use the outermost leaf layer to make a clingfilm type of covering to preserve and protect food, especially that taken by workers to their place of work in the local fields. Agave atrovirens and agave salmiana seem to be used for this purpose. In some parts leaves and flowering panicles are used as cattle feed.

2) Drink Source.
There are two main liquid products of the agave. The natural juice of living plants is called 'aguamiel' (honeywater) in its fresh state and ' pulque' when fermented, whilst the distilled product is known as 'mezcal', which if manufactured in the region of Tequila from an authorised distillery is 'tequila'. The process of distillation was unknown to the native population before the Spanish conquest whereas now in the twentieth century it is a thriving modern industry of marked economic importance.
The natural juice of the agave has probably been drunk by man for probably 2,000 yrs.although the Aztecs seem to have been most instrumental in the usage of this beverage, especially in its fermented form. The evidence for the role of agaves and their juices (amongst other roles) has come from primitive pictographs and codices, studied extensively by Spanish and other European scholars, giving us some idea of the value of these plants in various aspects of native life. One of the best sources for this information is Goncalves de Lima in 'El Maguey y el pulque en los codices Mexicanos' (1956). A mural dating from about 1000AD called 'Pulque Drinkers' was found in 1968 at the great Pyramid at Puebla, 70 miles east of Mexico City. Many of the archeological sources seem to imply that the Aztecs 'invented' pulque between A.D. 1172 and 1291 during their migrations but it is highly likely that they only extended and improved an already reasonably well developed art. There is documented evidence of the cultivation of agaves for the production of aquamiel in 1224 and pulque in 1239. Pulque, or octli as it was known to the Aztecs, was described in an Olmec text as a " delight for gods and priests ". It had mild alcoholic effects and these were supplemented by the addition of sap from other plants,roots, barks and herbs and the finished products were

then used in various religious and allied ceremonies, including human sacrifice.
Whatever had preceeded the Aztec era it was this particular civilisation that extended and refined the use of the agave as a source of beverage. Farming of the plants became a properly organised and supervised activity. Habitat agaves became the source of a range of plants suitable for farming and the production of food and drink. As time went on the Aztecs were able to select better and better varieties for their specific needs and experimented with various plants, new tools, different soils and improved methods of cultivation, thus producing ever improving forms of food and drink. The consumption of the finished products was under fairly strict control, mainly under that of the priests and others involved in the organised religion of that particular era. It was they who decreed who could drink and when. It was also the tradition that anyone involved in the preparation and serving of pulque at special events could have no contact with women, as this was likely to make the beverage too bitter to consume.
In spite of subsequent developments in the post conquest era, pulque continued to play a special role in Mexican history. Produced on a larger scale by a relatively small group of Mexican landlords it created enormous power and wealth for this elite, a development that helped to trigger the Revolution of 1910. The huge haciendas, once owned by these ' pulque barons' , can still be seen in and around Mexico City.
The cultivation of agaves tended to be combined with the cultivation of other farm crops and provided intensive all year employment for many. Pulque was so important that a special pulque customs service was set up to charge duty on traffic of the drink into the capital.
Along with mining the farming and production of this beverage were amongst the most important contributors to the Mexican economy by the end of the nineteenth century. It tended to be drunk in special bars called ' pulquerias ', also usually owned by the already rich hacienda owners, further lining their pockets. Each individual pulqueria was identifiable by its specific nameplate, decor and songs. The working people used to frequent these establishments as opposed to ' vinaterias ' or wine bars frequented by Spaniards and the richer classes. Nowadays these bars are mere museum pieces as pulque has been replaced in popularity by beer and production is on a small scale and local use only. Pulque street sellers were also a common sight in these times.
The chief source of pulque is the Agave salmiana family, although many other varieties have been found in use including Agave atrovirens, americana, hookeri and mapisaga. Cultivated forms of this agave grow in huge abundance in the central plain of Mexico and can be seen in large numbers on all routes out of Mexico City. When the plant is ripe after eight or twelve years it produces a sweet liquid called aguamiel over about a year or so, one plant producing in total about 2,500 litres. The aguamiel collects in a cavity scraped out in in the plant core by an operative called a ' tlachiquero' using a long tool called an ' acocote'. This process is repeated several times a day during the production period and the liquid is then taken to fermentation vats where it it is converted to alcohol utilising it's own natural fermenting agents. The production site is called a ' tinacal'.
Once the natural agave juice has fermented, apart from its alcoholic properties it is a nourishing source of a variety of minerals, proteins and vitamins and is widely used today amongst native Indians as a food supplement as well as for its refreshing qualities. It is on sale locally in markets and via streetsellars, is considered to have medicinal properties and act as an aphrodisiac. It is a milky, slightly foaming fluid, somewhat viscous in consistency and has been described as tasting like bittersweet beer. It's alcohol content is low, generally between 4% and 8 %.
Following the European conquests the Spaniards tried bringing in grapes and grains to recreate popular European drinks such as wine and beer but the results of cultivation were relatively poor in the land where the agave thrived. The taste of pulque did not satisfy the Spanish palate and so the process of distillation, learnt from the Moors in 800 AD, was

introduced and resulted in the manufacture of mezcal (or mescal). This term is the generic name for the products of distillation of agave juice and derives from a prehispanic Indian term for the agave plant. At first unsupervised distillation was an illegal activity because of the competition it provided initially for imported Spanish products and later for the produce of the numerous rural estates or haciendas set up as part of a profitable commercial network. The first recorded plantation and factory was that established by Don Pedro Sanches de Tagle, Marquis of Altamira around 1600 and in 1608 the governor of Nova Galicia, as Jalisco was then known, imposed the first taxes on this mezcal wine, as it was called. The tax on the sale of alcohol during the colonial period represented a large revenue to the Spanish Royal Treasury. At one period it equalled half the value of the production from the silver mines in New Spain. There were also periods of prohibition, perhaps due to political conditions and social unrest. For example, a royal order was signed on May 3rd 1785 in Spain which banned the manufacture of alcoholic beverages in New Spain and this was in force for a period of 10 years.

For many years production was mainly confined to small producers, often tax dodging farmers, using primitive and not always efficient methods and plants not always suited to this type of usage. As a result it was very much something to be drunk 'at your own risk'. From the early part of this century however it is an increasingly thriving industry, limited however by problems in raw material availability due to over exploitation and by the antiquated and inefficient methods of production. Although many forms of mezcal are produced throughout Mexico , the southern state of Oaxaca is the major centre of commercial production, where the production was modernised and expanded markedly between 1950 and 1970. Here lives 25% (900,000) of the total Indian population of Mexico and every town and village is involved in some way in the growing and harvesting of the agave plants which are subsequently sold as a cash crop to local distillers.The principal plant used is Agave angustifolia but in many areas it's use is supplemented with 'Maguey Verde' belonging to the species Agave salmiana ssp. crassispina plus Ag. potatorum, weberi and scabra
Mezcal ,and indeed it's geographical variant Tequila, are products of the stem and leaf bases ('pina') of the agave plant, also known as the heart. It has been well known for many, many years that in order to obtain high quality raw material it is necessary to castrate the plant in order to halt the development of the flower stem whilst still allowing and encouraging the flow to and storage in the plant stem and leaf bases of the various rich nutrients originally destined for the flowering process. The people in charge of castration are called 'picadores' and it is their job to identify plants that are ready for this process by looking for very specific changes in the terminal spine of the central stem bud. A plant which exhibits suitable features is called 'maguey acarrilado' and is usually between eight and twelve years old. The central stem bud is then sliced transversly to reveal a central,hollow circular orifice,which is the necessary proof of the suitability of the plant. The picador, using a sharp instrument called a 'palanca' then proceeds to remove the developing flower stem. Attempting to do this in the absence of the central orifice means the certain demise of the plant.
Castration may be carried out at any time of the year and following this procedure the plants remain for six to eighteen months filling up with the carbohydrates originally destined for flowering before the harvest ('rajado') takes place. It has been estimated that some 50,000 plants per month are used in mezcal production. The next stage of the process is the collection and transportation of the plants to the factory. Teams of three men are generally employed for this task, a 'desvirador' who locates and trims castrated plants and two 'tumbadores' who lever the 'pina' from the ground and prepare for transport, which mostly still utilises mules although the tractor is gradually getting the upper hand.
Having been delivered to the factory the 'pinas' undergo the stages of cooking, mashing, fermentation and distillation. The ovens (' los hornos') used for cooking are generally made

of stone with a front and sometimes rear door for loading and unloading, a hole at the top for topping up and a grill of wood or stone underneath, overlying the heat source,which is either steam or a naked flame. The cooking period consists of three to five days and produces juices called 'guixi' . The traditional alternative is to place the pinas in a 'palenque', a rock lined conical pit measuring some 12 feet in diameter by 6 feet deep. They are covered with hot rocks that have been heated in a wood fire and then by a layer of leaves, plant fibres and earth baking in this way for 2 or 3 days, absorbing flavors from the earth and wood smoke. The cooking process breaks down the complex sugars to simple ones and the 'pina' in this form is known as 'mezcal'. The supervisors of this part of the chain of events are called 'faineros'
The mezcal is next broken up with axes in order to facilitate the next stage, the mashing process. The traditional method consists of the cooked plants being put in a circular stone pit at the centre of which is a vertical pole. This is linked to a large stone wheel called a 'tahona', by means of a horizontal axle and mules are used to turn the wheel. The people in charge are called 'molineros'. There are two products as a result of this milling: the juice, which is guided out to fermentation tanks in special channels and the solid remnants of the mezcal. This material, called 'bagazo' is then washed through to extract every ounce of juice and the remnants are stored in the factory yard, to be used later as livestock food. In some distilleries the juice and solids are fermented together and not separated until the distillation stage.
With 10% added water, the juices are fermented in vats of stone , of cement lined with wood or of steel, this lasting up to ten days if done naturally or 24 hours if a seed syrup ('xinatli') and ammonium sulphate are added. Finally the stage of distillation commences in copper stills, heated either by flame or by steam and controlled by a distiller called a 'alambiquero'. The first ten or so litres of each run, the 'head', are discarded because of a high concentration of methanol as are the last few litres, the 'tail', because of their low proof. This tail however is added to the next run to be redistilled. The collected portion of the beverage is maintained at about 90 proof, representing an alcohol content of between 35% and 55%,and total annual production is over 1.5 million gallons (1996), bottled and sold in various parts of Mexico. It appears that sales are at their peak during the winter months. By law the product must contain a minimum 51% of sugars of agave origin, the other 49% may come from non agave sources such as cane sugar, corn syrup, almond essence or caramel. True 100% mezcal (and indeed tequila) is labelled "100% Blue Agave" and display a government NOM number which identifies the source of production. The Mezcal producers of Oaxaca have been able to protect their produce in international law by government issue of AOC regulations, similar to the Appellation d'origine Controlee system used by producers of cognac, champagne, port and sherry. There are currently 160 mezcal distilleries and 80 brands produced. Since 1994 exports of mezcal have tripled and now stand at 470,000 gallons, worth over 6 million dollars a year, of which 30% goes to the United States, 20% to Asia and the rest to Europe, South America and South Africa. In the 1950's a mezcal liqueur was created with an alcohol content of about 30%.
The liquid is sometimes sold with an agave worm, Hipopta Agavis,known as a ' gusano de maguey', in the bottle. The worm is in fact a butterfly caterpillar and comes in two forms: red, found in the body and leaf bases of the agave plant and the white which inhabits the outer leaves. The worm is considered a great delicacy and is found on sale in many a Mexican market. Apparently in the last century the worm was used as a marker for the suitability to drink of a sample of mezcal i.e. having been introduced into the bottle if it was still wriggling by the time it reached the bottom the liquid was safe to drink!! This particular variety of mezcal is called Mezcal Con Gusano, bottled 4-6 weeks after distillation and served with gusano salt, a mixture of powdered worm ,salt and chili often supplied in a bag attached to the bottle. The use of the worm as a marketing ploy is relatively new and was started in 1950 by an entrepreneur called Jacobo Losano Paez. The Tequila worm is a myth because it is never found in true tequila bottled in Mexico. Some blended tequila is sold in bulk to the USA

where it is bottled and not subject to Mexican Tequila laws thus a worm can be added at the whim of the local USA producer.
Apart from Oaxacan mezcal which is beginning to rival tequila, there are numerous varieties of mezcal produced throughout Mexico, although many are not yet available commercially and are produced and sold locally, often clandestinely to avoid tax. Sotol from Chihuahua, Tlahuelompa from Hidalgo and Raicilla, produced from Ag. inaequidens or Ag. maximiliana in the tequila state of Jalisco, are well known in the localities of their production, Raicilla recently achieving legal production status but as yet on a tiny scale.
In the northern state of Sonora there is emerging a trendy new variety of mezcal called bacanora, which appears to be rapidly gaining popularity as the status drink of the region. It is new in the sense that it's production has been legal only since 1992 and previously could only be obtained from bootleggers. Now there is limited commercial bottling and distribution of Sonora's most traditional drink. Nevertheless it is still a rare find even in Mexico and while the multimilion dollar tequila industry depends on agave plantations and modern machinery, bacanora remains true to its primitive and rugged origins. Using Agave angustifolia (cf. Ag. pacifica [TRELEASE]) as the raw material, the brewers gather the wild growing plants in the prickly and hostile central Sonoran foothills, needing six dozen or more plants to brew a 5 gallon batch of bacanora. Once the plants are prepared and harvested they undergo cooking, fermenting and distilling in wide open wilderness, in clearings surrounded by brush and cacti. For 2 days the agave hearts are roasted over the hot coals of a wooden fire inside a stone lined oven dug 6 feet into the earth and then they are mashed in containers made from hollowed out tree trunks. Next they are placed in another pit dug in the ground, sprinkled with water and covered with thorny tree branches to ward off cattle and other inquisitive animals for five to seven days of fermentation. The fermented pulp is carried in sacks to rudimentary stills set up near sources of fresh water. After a double distillation the first, middle and last extracts are collected separately in containers and subsequently blended into the ultimate product. There are about 500 families in Sonora involved in making bacanora, often as a subsidiary business to running their farms. One commercial bottling plant exists which buys batches of drink from the family brewers, assuming these batches pass quality control. 8,000 litres are bottled for annual sale and there are now two distribution companies. It is a stiff drink , logging at 92 proof and served neat, unaccompanied by salt, lemon or anything else that might spoil it's rich, woodsy taste.
Far and away the most economically important product of agave juice is tequila, important both on the internal market and significantly as an export currency earner. The name derives from an ancient Indian term variously interpreted as : ' the place of harvesting plants'; 'the place of wild herbs'; 'the place where they cut'; 'the place of work'. The relationship between tequila and mezcal can be compared to that between brandy and cognac, armagnac being the equivalent to Oaxacan mezcal in such an example. There is a similar relationship between sparkling wine and champagne. Thus all tequila is mezcal but not all mezcal is tequila. All produce is derived from various cultivated varieties of Agave tequilana , commonly known as 'Maguey Azul', 'Weber Tequilana Azul' or the 'Weber Blue Agave'. The centre of this industry is in the state of Jalisco, where 60% of all factories or ' fabricas' are located in the region of the town of Tequila (pop. 18,000), lying 60 kilometres northwest of Guadalajara on the hilly territory of an inactive volcano, and where 80% of the world production is found. To qualify as genuine Tequila, the drink has to be manufactured in one of two municipalities, either that of Tequila or that of Arandas to the northeast of Guadalajara. Of the twenty or so currently licensed distilleries only two are to be found outside the state of Jalisco. They are to be found in Taumalipas and were granted a production licence in 1973. The tequila produced here is called Chinaco and appeared originally in 1983. At present the industry employs 38,000 people, of which 33,000 are actually used on the agricultural side of the manufacture as opposed to 5,000 used in distillation. However the industry is in crisis at the moment and the

twenty distilleries are the remnant of a total of ninety or so just a few years ago.There is a shortage of plants, in part due to a devastating fungal disease which destroyed some 20% of the total agave crop in 1997. The total from the whole region of production amounts to over 190 million litres of tequila each year (compared with 50 million in 1990), of which 97 million are exported, the bulk going to the United States. In 1999, Mexico exported 80 million liters of tequila to the United States, up 48 percent over 1995. The current annual value of exports is 200 million dollars.There are some 580 brands of tequila in production at present compared with 35 a decade ago.

In 1758 Jose Cuervo was given rights by the Spanish king to develop plantations of agave plants for the purpose of producing distillate in Jalisco and a year later production rights were granted. This was in effect the foundation of the tequila industry and a distillery bearing this name is today one of the major producers. The first commercial distillery was begun in 1785 by Pedro Sanchez de Tagle. It was under the Cuervo label that the first bottled tequila was produced in the late 18th century. The first recorded factory in the area was in 1621 but for a time the Spanish suppressed production so as to promote their own imported goods. However a lot of illegal production went on and ultimately by the end of the 17th century the Spanish realised that they were far better off taxing production rather than trying to supress it. These beverages gained prominence only really after 1821 when Mexico became independant of Spain and Spanish products were not so easy to obtain and many of the distilleries in production today were founded in the later part of the 19th century. At present in Jalisco there are more than 90,000 acres given over to the cultivation of Maguey Azul with each acre planted with up to 2,000 plants or 'mecuates'. There is a rough estimate that there are some 100 million agave tequilana plants in the area. The plantations are called 'potreros' or 'campos de agave'.Studies show that the best growing conditions for the tequila plants is a warm, dry climate in a soil that is not too sandy or contains too much calcium, as this seems to retard sugar production. Propagation of plants is via offsets ,which are raised in nursery beds and transferred to commercial plantations upon reaching a weight of 750 grams. They are then planted out in rows during the rainy season as no artificial irrigation is used in the cultivation of the maguey. In the last couple of years many plants have been wiped out by a rampant fungal disease which, in addition to the snow of 1997, has in turn made these agaves more valuable and pushed up the ultimate price of Tequila. In 1999, 730,000 tonnes of agave plant were available for harvesting whilst it is estimated that in 2002 only 270,000 tonnes will be available. Some of the larger concerns with extensive plantations are now forced to employ security firms to protect their plants from agave rustlers. These problems have led to much research, now quite well advanced, into the possibility of cloning agaves and thereby having a ready source of plants which also appear to be more disease resistant than the plants available up to now.

The process which then follows is similar to that described above for the mezcal industry, although traditional methods have by and large been superseeded by more modern practices eg. transport by tractors and not mules, cooking in steam autoclaves not stone ovens and mashing in electric presses or mechanical shredders and not stone circles. Where the latter are still used, tractors have replaced mules in the process of turning the stone wheel .The heat source for final distillation is steam and not wood, the whole process being much more clinical than traditional as in the case of much mezcal production. The drawback is that tequila lacks the fine woody or smoky aroma of mezcal. The basic principle is again to remove the early flower stalk ('quiote') to force the plant to store its various nutrients in the stem, which then grows in size and is harvested with a crowbar type instrument called a 'cua' as the 'pina' or ' cabeza' , which can weigh between 70 and 150 pounds (27 to 55 kg). Each 'pina' contains enough raw material for about 5 litres of the finished product.

The flowering age of these plants is anytime after 4 years when they are ready for harvest. During the years of growth the older leaves are cut off and prior to harvesting the leaf tips are

removed in order to stimulate further the production and storage of carbohydrates in the stem. Once a suitable plant has been identified the leaves are removed leaving a spherical 'pina' which is levered out of the soil and delivered to the factory . The whole process is called the ' jima' and the workers ' jimadores'. At the factory cooking is the first stage, converting the stored carbohydrates, mainly inulin, into it's component sugars i. e. fructose and glucose. It continues for up to 48 hours, depending on the type of cooking device used. The cooked material is then transported on conveyor belts to the mill where it is shredded, washed and pressed, separating out the juice from the fibre. This waste fibre or 'bagazo' is used for fuel, furniture stuffing, in brick manufacture, as an organic fertiliser and as livestock fodder. Further research into the other potential uses of this fibre is being carried out at the University of Guadalajara. Some distilleries ferment juice and fibre together and it is not separated out till during the distillation process.

The most important part of the whole tequila manufacturing process is fermentation. The sugars from the collected juice are converted to alcohol in stainless steel vats , specific yeasts, both natural, cultivated and commercial being utilised and nutrient nitrogen and phosphorus salts added, the whole process taking 72-150 hours. Legally ,until 1995, the minimum agave juice content in this process had to be 51% and 49% could be from non agave sources such as cane sugar. After 1995 this minimum was raised to 60%. Where 100% agave is used the final product is proudly labelled ' 100% Blue Agave' .The alcohol content at the end of this stage is about 7%. Then follow two distillations (a legal requirement), in stills called 'alambiques', the first distills the fermented mash and results in 'tequila ordinario' with an alcohol content of 22% and a waste product called ' vinaza', whilst the second produces 'tequila rectificado', which has a much higher alcohol content of 55%. The beginning and ending fractions of the rectification process, called 'heads' and 'tails', are also a waste product and used in the paint industry. The final product of distillation is called 'tequila blanco' which is either already distilled to 80 proof or is distilled to 120 proof and then diluted to 80 proof for the national market or exported all over the world. The strength is equivalent to an alcohol volume of about 40%.Tequila can be bottled as the final product of this process or be put into barrels for ageing. Bottling and labelling is often done by hand and the filled cases are inspected by the Consejo Regulador (Tequila Regulating Council) and sealed . Government inspectors watch over the whole process and there is strict quality control. In 1978 the NOM (Norma Oficial Mexicana) was established to supervise, control, and verify all the activities involved in the agricultural, industrial and commercial processes in the production of tequila.As marketing ploys fancy packaging, wooden boxes and elegant bottles, often handmade, are now quite common, especially with the premium tequilas, and soon turn into collectors items.

In rural Mexico mescal/tequila can be found in pharmacies, grocery and hardware as well as liquor stores. Medically it has the reputation of cleansing the blood, being an antiseptic to clean cuts and bruises,curing syphilis, lowering cholesterol and acting as a tonic, indigestion remedy, diuretic and laxative!!!!! In addition to all of these it is promoted as a top class aphrodisiac. It is sold as after shave lotion, insect repellant and lighter fuel.

Tequila was first legally imported into the United States in about 1870, became very popular amongst the American soldiers involved in the Mexican revolution in 1916. At this time it achieved a sort of national status in Mexico by its association with gun slinging anti government rebels. It was extensively smuggled across the border during the prohibition. During World War 2 it's popularity rose further in the USA as spirits from Europe became increasingly difficult to obtain and gradually it crept ever higher in the alcohol popularity stakes. In the1950's it was popular with trendy Californians because of an erroneous rumour that it contained mescaline, a psychedelic cactus derivative and subsequently achieved major world exposure during the Olympic games in Mexico in 1968. Then the growing tourist boom, primarily Americans, ensured that by the eighties it had achieved true cult status.Between 1975 and 1995 sales in the United States increased by 1500%. making it the

world's largest importer, followed by Canada, France and Japan .
Various changes in the methods of production and laws governing the whole process developed primarily from the earlier part of this century. Modern production techniques including the use of cultivated as opposed to natural yeasts were introduced in the late 20s. A decade later the decision was made to allow the use of non agave sugars in manufacture, an ill thought out move which had a negative effect on the reputation of tequila and by 1960 distillers could use 30% non agave sugars, a figure which went up to 49% not long after. In 1944 came the first moves to regulate the industry and in that year the Mexican government decreed that all tequila was to be agave distillate from the state of Jalisco. The first formal Tequila Laws came along in 1947 and have been modified and upgraded regularly since then. In 1974 there was international recognition and acceptance as a product originating only in Mexico under the AOC designation (Appellation d' Origine Controlee), finally ratified only in 1996. Originally Japan had challenged Mexico's status by producing it's own version of tequila and more recently in 1997 a South African distillery announced the production of 'tequila' from naturalised agaves but containing only 10% true agave sugar. Mexican protests have forced a change of name from tequila to 'Spirit of Agave'.
A pasturised form of agave juice called 'miel de maguey' is exported to the U.S.A. as a refreshing drink. Several agave liqueurs called ' elixir de agave' are in commercial production and recently an agave beer called Tequiza has been launched.

3) Fibre Source.
It is likely that agave fibre was in use by 7000 B.C. as Gentry says ' man would have recognised the strength and use of agave fibres when he began eating them, because he had to cut the fibrous leaves from the nutritious leaf base and stem'. Legend has it that an ancient king of Mexico was riding across the Yucatan peninsula when he was injured by the sharp point of a henequen plant. He ordered the plants to be cut and destroyed. While the plants were lying in the sun the king noticed that each leaf had long fibres and he ordered that all the fibres be gathered and woven together to form a long rope. He declared that in the future he would be the master of the evil plant and that forever the plant would work and be a slave to the people.
Sisal is the generic name given to the natural fibres obtained from the leaves of an agave plant , the local Mexican term being 'henequen'. The name sisal is derived from the name of the Yucatan port from which this product was first shipped around the world.There has been for years a thriving industry amongst the local population producing a wide variety of articles to be seen on sale in many a local market. The main centre of the industry is the southern state of Yucatan and during the nineteenth century the Yucatan peninsula saw a boom in the exports of these natural fibres that brought prosperity to those involved. Amongst these items can be found examples of rope, cord, bags, clothing, footwear, brushes and other household goods, musical instruments and weapons. There is an excellent example of an Apache musical instrument in the U.S.A National Museum. This consists of a hollowed out agave flowering shaft which is played by a bow made from agave fibres. The Aztecs used this fibre in the manufacture of an all purpose sack or bag called an 'ayate' and it was on one of these sacks that in 1531 was imprinted the image of the Virgin of Guadalupe, since then the Patron of Mexico.
Rojas Gonsalez (1939) gives an excellent account of the industry as pursued by the Otomis from the state of Hidalgo. The work is divided amongst the sexes, the men and boys separating fibre from leaves, the women and girls doing the weaving. Agaves used include salmiana, americana, striata and lechuguilla, the sap of which appears to be an excellent cleansing agent.
Nowadays more modern methods of production have tended to push the older industrial form somewhat into the background. The older,traditional way of doing things nevertheless has a

long and proud history. When the Spaniards came and brought along horses and mules, the agave fibre became a raw material for harness, bridles and saddles and also from that period the production usage for furniture e.g.beds, chairs increased rapidly. Once agaves began to be farmed on an extensive scale in plantations the production of fibre items spread beyond the confines of their original homeland. Although henequen fibre (from Agave fourcroydes) is mainly produced in Mexico itself (also Cuba), sisal fibre (from Agave sisalana), the stronger of the two fibres, has been produced in Brazil, Haiti, Madagascar, Angola, Tanzania and Kenya. Agave sisalana supplies some 70% and Agave fourcroydes 15% of the world's hard long fibre as rope, twine and bags (Gentry 1982). Agave lechuguilla is the principal source of hard fibre known as istle or ixtle, used for rope, twine, brushes amongst others. It is also known as ' Tampico fibre ' and used still in the USA and Europe for the manufacture of brushes.

Mexican production was centred on the Yucatan peninsula based in haciendas. These ranches developed at the end of the colonial period in 1810 mainly as mixed haciendas producing a variety of items such as corn, meat, sugar and cotton. By the end of the 19th century many of these haciendas had become 'henequen haciendas' devoted solely to fibre production. Before the mass production of henequen in the haciendas, the cultivation of the native agave "fourcroydes"was associated to the Mayan culture of the peninsular region since pre invasion times. The fibre obtained was used among the Mayan to manufacture thread, canvas sandals, arms for hunting, pitchers of water, etc. This tradition maintained itself among the indigenous people for thousands of years and just as the henequen was cultivated by the ancient Maya, so the tradition of cultivation was continued on the haciendas of the 19th century.

To produce the fibre the leaves of the plant are cut by hand and transported to a mill where the fibre is separated from the pulp by machines. The fibres are then dried in the sun and twisted to produce cord. The natural characteristic of the fibre is one of coarseness and inflexibility but when beaten and pulped to a high degree it can be turned into a silky fabric easy to print or dye and light enough to be worn in hot weather. It is thus also used as a silk substitute in the clothes industry.In competitive terms agave fibre now loses out heavily to synthetic rivals such as rayon or nylon because it can only be successfully and competitively produced where there is a cheap and plentiful source of hand labour.

4) Other Uses.

We know that the Aztecs and other native Indians have used immature agave leaf fibre and sap in the production of paper and also as poultices for wounds, rashes and bruising. Some agaves e.g. Agave vilmoriniana are known to contain medically useful substances such as vitamins and steroid precursors. Research is being carried out to see if any of this may yield products of medicinal and commercial value and at present the indications are that in the future agaves may have more of an application in these areas than in their more traditional roles, with the possible exception of Tequila production. Soap or soap substitutes are produced from a number of different species including Agave lechuguilla, the sap of which is also known to be used by locals as a poison for the tips of their arrows. Others useful in this role are schottii, difformis, toumeyana and vilmoriniana. The flowering poles can be used as fences, in house construction (in addition to leaves being used in roofing), as fishing poles and tree supports. A form of digeridoo called Dream Time Pipes is now being marketed in California, using hollowed out agave flower stalks to replace the original hollowed out eucalyptus trunks. Surfboards are also made, albeit on a small scale, from the flower stalks. Recent advertising promotes a food and drink sweetener from agave juice, a bosom firming cream containing agave extract, an antiseptic from the sap of Agave filifera and a liquid treatment for falling hair in which the leaves of the same agave have been soaked. The essence of the flower of Agave palmeri is sold to help us promote our inner selves " This agave helps us to own our level of mastery and manifest our inner beauty and strength into

daily life".

Nomenclature

In 1871 Sir Joseph Hooker wrote " Of all cultivated plants none are more difficult to name than species of Agave, partly because of the imperfection of published descriptions, and more from the impossibility of fixing their characters by words". Botanists up to modern times have continued to be confused and baffled in their understanding of agave species.
Amongst the first Europeans to see and collect these plants was Columbus in his first voyage of 1492-93 and the first recorded agaves in Europe appear in documents soon after 1520. The origins of the earliest named plants are quite obscure and it is likely that the first agave taxonomists knew precious little about how the plants had come to them and where they had been originally collected. A lot of material was supplied by collectors in the form of immature plants (destined never to show their true selves by being grown in artificial and very un Mexican like conditions) and seeds. Proper keeping of records was not a recognised activity at that time. According to Gentry the best source for the names and destinations of the early agave collectors is Hemsley (1887). Many well known names collected agaves on their travels including: Schiede (1828-1836); Karwinsky (1825-1831); Ghiesbreght (1837-1858); Wislizenus (1846-1847) and Seemann(1848-1866).
The genus was essentially founded in 1753 by Linnaeus, who replaced the universal usage of the term aloe for these plants with the new name agave and presented an initial listing of four species: A. americana (possibly A. lurida [AITON]); A. vivipara (possibly a West Indian species, no living specimen ever identified); A. virginica (= Manfreda) and A. foetida (= Furchrea).It was in fact this eminent Swedish naturalist and physician who in his great work 'Systema Naturae' provided a much needed framework for identification and devised a precise and concise system for naming plants (and animals) , using one Latin (or Latinised) name to represent the genus and a second to represent the species. i.e. the binomial system. During the next hundred years or so the importation of agaves to Europe reached its peak and consequently the nomenclature gathered pace and many new names came into being, generally based on little solid evidence and more for the convenience of collection owners.
After Linnaeus the next important agave taxonomist was an Englishman named Philip Miller who added four new species : A. tuberosa (= Furchrea) ; A. rigida (origin unknown) ; A. karratto (from St. Kitts) and A. vera-cruz (possibly A. lurida). Haworth added a further four species : A. angustifolia ; A. flaccida ; A. mexicana and A. milleri. Of these names only the first is recognised today.
In 1833 German botanist J. G. Zuccarini studied plants brought back by Karwinsky between 1827 and 1832 and added five new species : A. potatorum ; A. heteracantha ; A. macrocantha ; A. pugionoformis and A. karwinskii. He also was the first to describe extensively agave flowers but he did not utilise flower characteristics to delineate species.By 1834 Prince Hubert Salm-Dyck had developed a listing of 34 plants ,based on his collection at Dusseldorf. He increased this listing to 47 species by 1859, dividing the genus into five main groups. One of the most prolific authors was General Georg Albano von Jacobi, who was very active in the field of agave naming between 1864 and 1867 and initially produced a list of 78 species with numerous and multiple varieties whilst his final tally in his classification was 157 agaves and 18 Furchreas. Unfortunately his work was based entirely on specimens observed in gardens and greenhouses around Europe, plants that were often immature and not of a natural habitat appearance.
Later in the nineteenth century Sir Joseph Hooker in 1883 classified 120 species and John Baker in 1888 in his 'Handbook of the Amaryllidae' recognised a revised total of 138 species subdivided into three main subgeneric groups further subdivided into sections. It was indeed Baker who in the Gardener's Chronicle in 1877 had first introduced the subgeneric terms

Littaea and Euagave,which Gentry in 1982 renamed Agave,and this is used today as a main generic division into plants with spicate and paniculate inflorescence. Like Zuccarini before him Baker was familiar with and described the flowers of many agaves but did not use floral characteristics in his classifications. In fact it was the French botanist Cels who first described the two different types of agave inflorescence. In 1885 Achille Terraciono attempted to rationalise the classifications so far and to reduce the total numbers involved by regrouping and also by converting species into varieties.

Probably the most influential figure in agave taxonomy until the early part of the twentieth century was Alwin Berger, curator of the famous Hanbury Gardens at La Mortola in Italy. Here there were near perfect growing conditions and a huge number of agaves was assembled, obtained from European and Mexican collectors.The original collection here had been established in 1868 by Ludovic Winter. In 1915 Berger produced his famous work 'Die Agaven' which cited 274 species subdivided into 3 subgeneric groups, namely Manfreda, Littaea and Euagave.Littaea was subdivided into 7 sections and Euagave into 18, both then further subdivided into classifying groups.

In the New World George Englemann (1875-1911) was the first major contributor to agave nomenclature, followed by Elizabeth Mulford who in 1896 produced a finely illustrated classification of the American species. William Trelease, a contemporary of Berger, succeeded Englemann at the St. Louis Botanical Gardens and travelled extensively in Mexico, the Caribbean and Guatemala producing several important works on nomenclature between 1907 and 1924. In spite of being able to travel through agave territory and make significant observations and records of agaves in habitat he nevertheless still relied mainly on cultivated material and often separated species on the basis of relatively minor vegetative variations. By 1925 Trelease and Berger had provided a total of 310 recognised species.

The agaves had initially been set up as a family group in 1836 by the Austrian botanist Stefan Endlicher and included the genera Agave and Furchraea. Thirty years later the family grew with the addition of Manfreda, Polianthes and Yucca. It was classified in the Amaryllis Family until 1934 when John Hutchinson of Kew , realising its close relationship with the Yucca ,belonging to the Lily Family, combined the two plus 17 other genera in a new grouping, the Agavaceae. This has remained as the recognised Family name until now although there have been further reclassifications of some of the other genera since 1934.

In 1960 Jacobsen revised and slightly reorganised the previously accepted nomenclature but did not in fact make any major new contributions. In 1982 came the most important new revision of agave names in recent times. Howard Scott Gentry produced his work 'The Agaves of Continental North America' in which he divided the genus into two subgeneric groups, Littaea and Agave, the former comprising of 8 family groups and the latter of 12 groups. There is a further subdivision into 136 basic species, made up of 197 individual taxonomic units. Although he relied to some extent on the previous work of Trelease and Berger he introduced important new concepts in nomenclature which allowed him to revise quite extensively the available data. Apart from reviewing most known herbarium species he travelled extensively collecting and observing plants in habitat and was meticulous in documenting his work, unfortunately a practice not commonly employed by his predecessors.As a result of his great monograph Gentry has been very much regarded as the foremost expert in this particular field and in spite of his recent death his name will very much continue to represent THE great agave scholar of the current age.

Time and research however move on and in the years since 1982 further study has been able to redefine even some of Gentry's concepts as well as earlier work. Some species have been identified as suitable for combination whereas others for division into varieties or subspecies and some have been moved into different family groups.

One of today's leading experts is Bernd Ullrich from Germany who has, for example, reclassified Gentry's Agave pygmaea as Agave seemanniana ssp. pygmaea, has reclassified

Agave schidigera and Agave multifilifera as subspecies of Agave filifera and has created a new group called Guatemalenses to include many species from Gentry's group Hiemiflorae. He has produced a fascinating paper showing that Agave scabra (SALM-DYCK) is really a part of the parryi group and Agave asperrima (JACOBI), quoted as a synonym for Agave scabra in Gentry, is the correct name for this plant.
The earlier European taxonomists based their initial classifications primarily on leaf appearance.There was no use of preserved specimens or illustrations or indeed any notion of using variety in inflorescence as a tool of classification. The descriptions were based most frequently on potted, often immature, plants grown under variable and artificial conditions in greenhouses and it was not realised , or perhaps conveniently forgotten, how different the same plant may look when grown under varying conditions. Species of agave are quite variable in their appearance and can be influenced by differing states of temperature, light intensity, shade, soil and pot conditions. This idea is further brought into focus by the fact that in habitat agaves may exhibit marked variations depending on the enviromental influences of their surroundings. The specimens on which the early names were based may have been grown in conditions which may have varied from a potted plant in a greenhouse in northern or central Europe to a relatively warm outdoor site in the south of the continent. Each slight variation of colour, leaf or tooth structure or in markings seemed to give birth to yet another new species or variety which accounts for some of the vast original lists. These early names are still however of relevance today as they provided a framework for subsequent research to be based on and are still often to be found describing plants in collections and on sales listings of succulent nurseries and seed merchants. Baker in his work of 1877 was the first to mention and describe agave flowers to any great extent but made little use of these characteristics in his efforts at classification. Berger certainly made more use of the variability in inflorescence in 'Die Agaven' but whereas he used these features to differentiate family groups he tended not to use inflorescence at the species level. Trelease was the first important expert to travel extensively and observe at first hand populations of agaves in habitat, using living specimens, herbarium specimens and illustrations to aid his work. He made some use of floral characteristics and often relied on visual markers in the specimens under study, some specimens being more suitable for this purpose than others. Johnston in 1924 tried to relate species to floral and population characteristics but his work was confined to a small geographical area of the Californian peninsula. The idea that genetics may be of value has been around for some time and was initiated in the work of Granick in 1944. Others in this field have included Sharma and Bhattacharrya (1962) and Cave (1964) but so far there has been little practical application to the problems of nomenclature.
Gentry (1982) was the first important student of agaves to use inflorescence as a primary tool of classification. He was able on this basis to justify his relegation of many older species names to subspecies or variety status or indeed as synonyms thus reducing the contents of some older lists. It is likely that his lead will be followed in new research over the coming years, when we can expect further clarification in the complex area of agave names and his monumental work is likely to be the springboard for future developments.

Plant Features

The rosettes of the agave plant have, according to Gentry, characteristics that may lead them to be described as perennials and annuals. Since they take 7 to 20 years in habitat to flower they can in this respect be considered as perennials but if their life cycle is taken into account i.e. the fact that most mature and flower only once they would then be exhibiting the characteristics of an annnual. This particular feature of their lifespan is originally responsible for the myth that cacti flower only once in 100 years and gave agaves their often used name of the century plant.

The time interval before flowering is used by the plant to store various nutrients and mineral reserves which are then utilised in the formation of the flower stem. This structure emerges from the top of the body of the plant and subsequently grows rapidly attaining a height of 10 or 12 metres whithin the space of a few months. This process drains the mother plant which proceeds to wither and die but not before it has produced offsets which then mature and take over. The plants can also reproduce as bulbils, small offsets formed in the structure of the flower shaft, or ultimately from seed produced by the flowers. The formation of offsets, which occurs underground above the level of the roots either directly from the stem or from branches of the main stem (rhizomes), may occur at varying times of an individual plants life cycle i.e. some only when young, some throughout their lives and some only after the plant has flowered and set seed. The rosettes have stems of variable size and some form actual trunks e.g. Agave karwinskyi and Agave attenuata.

The shape of the rosette is a useful defence mechanism warding off foraging animals (and humans !!) thus protecting the vulnerable flower stalk and man has put this feature to good use in building protective fences of agaves around his property. The leaves are, with only a handful of exceptions e.g. Agave striata, thick and succulent and develop in a spiral fashion from the centre. They tend to be tightly centrally wrapped around each other during the process of maturation and as they develop into the finished article they unwrap and often leave the imprints of their margins on the leaf below, a process called 'bud printing' by Gentry. They have a specially designed structure to enable them to fulfill their role as storage space for water and nutrients and tend to be lined with a waxy cuticle which helps to prevent excess water loss enabling the plants to survive long periods of drought. They are usually hard or fairly rigid and fibrous inside and number between 20 and 200 depending on species. They often live for 12 to 15 years, in fact during the entire life of the plant. Eventually they finally whither and die when the plant matures and flowers. Another role for the leaves is to collect rainwater and direct it downwards and inwards towards the roots. In most species they are armed with lateral teeth lying on a straight or undulate margin, although in some species or forms these teeth are absent, whilst a sharp terminal spine is present almost without exception. Variations in these various leaf features have been extensively used, especially by the early taxonomists, to try and differentiate between and name new species but it is now realised how unsafe this is as a tool because of the huge variations in appearance caused by variable growth factors both in habitat and in cultivation.

Inflorescence is nowadays regarded as the method of choice in determining species. The genus is divided into two subgeneric groups , Littaea and Agave, based on the two main forms of the flower stalk. Littaea is represented by the so called spicate or racemose form where the flowers are borne as clusters close to the main shaft, Agave by the so called paniculate or umbellate form where the flowers are borne on branches lateral to the main shaft.Unfortunately nothing is ever so simple and clearcut in scientific study and to just to complicate matters there are intermediate forms in a few species e.g. Agave lechuguilla, Agave glomeruliflora and Agave potatorum. The size of the flower stalk may vary from 2 metres in Agave parviflora to 12 metres or so. Some species will flower readily in cultivation e.g. Agave parviflora and the most northerly outdoor flowering of an agave was recorded in Devon in 1820. Measurements of certain flower characteristics may also be made in helping to differentiate species or groups. Seeds are produced in abundance and it has been estimated that a single flower spike may produce as many as as 720,000 seeds(based on work carried out on Agave chryssoglossa). Pollination occurs through the agency of bats, various birds and insects.

There is a huge variation in size amongst agaves. The smallest is Agave pumila, measuring up to 10 cms in its juvenile form, a state it remains in for 8-12 years before developing into a mature open leaved rosette. At the other end of the scale the largest plants may measure up to 3 metres in height. These include Agave franzosinii (related to Agave americana) and

members of the salmiana group notably Agave mapisaga v. lisa, both of which interestingly enough are found in various botanical gardens but neither of which has been discovered in original habitat. These huge specimens may be 5 metres across with leaves 2-3 metres in length.

Mexico is the main homeland of the agave. The genus extends northwards to the southern parts of the U.S.A. and southwards to Central and the northern part of South America as well as being found in the Caribbean Islands. The bulk of agave species is concentrated in an area 250 kilometres on either side of Mexico city. The 250 or so members of the genus can be found in varying habitats eg. forests, hillsides, arid plains, deserts and sea coasts and at altitudes extending from sea level to 2400m (8000 ft.).They can survive a variety of temperatures ranging from -9 to +41degrees celsius (15 to 106 degrees fahrenheit). For those unable to visit the native habitats there are displays of these plants in various important European botanical collections: Kew; Edinburgh; Nice; Berlin; Munich; Frankfurt and Zurich to name a few. The Botanical Garden at Nice specialises in agaves and currently a large new area is being redeveloped in order to show an even bigger and more varied collection than at present. There are also the famous Hanbury Gardens at La Mortola on the Ligurian coast of Italy, near the French border, where Alwin Berger was curator at the turn of the century. For many years this botanical gem, containing all sorts of plants, shrubs and trees from temparate and tropical climates, was sadly neglected but recently having been taken over by the University of Genoa a lot of effort and hard work has gone into restoring the gardens to their former glory. The agave collection, now sadly missing many of the original plants described by Berger and Gentry, has in recent years been expanded and augmented with new plantings and efforts have been made to label plants where possible.There is also an excellent collection of agaves (amongst an incredible array of botany from around the globe) at the Villa Les Cedres on Cap Ferrat along the French Riviera (not normally open to the public but usually accessible on request). There are also many other less well known but nevertheless well run and interesting collections and gardens around the Mediterranean basin, one obvious one to mention is the Giardino Esotico Pallanca at Bordighera in Italy (not far from the Hanbury Gardens mentioned above).

Numerous impressive specimens of agave especially Agave americana and its variegated and non variegated varieties can be found growing wild having become naturalised in that area and are also used extensively for decorative purposes in parks and around buildings. Agave salmiana v. ferox is also widely planted as an ornamental. It is not uncommon to come across forms of Agave sisalana, angustifolia and fourcroydes.

In Britain agaves are chiefly grown under glass but outdoor cultivation of some species is possible under certain conditions, the most important of which is a dry soil for the roots in our cool and wet winter climate. Waterlogging quickly rots the roots. Thus most species grown outdoors need temporary cover in winter time but there are many quoted examples of plants lasting for many years without any protection at all. Many lists of winter hardy plants have been prepared over the years and each grower will have their own special suitable species but the names that appear consistently in these lists include Agave parryi, Agave utahensis and varieties, Agave parrassana, Agave salmiana and Agave americana, excluding however the various variegated forms which are not quite so tough and resilient.

Unfortunately many succulent enthusiasts are put off from growing agaves because they are not space friendly and tend to leave little room for anything else, but in fact there are many smaller species of varying shape, size, colour and markings which are quite suitable for the average garden or moderate sized greenhouse. Cultivation is generally quite easy, the essential requirements being plenty of sun and a porous soil. Bugs are rarely a problem but mealy bug can be a nuisance especially where agaves form part of a mixed collection.

This then is a portrait of a somewhat neglected and underestimated genus of magnificent

plants which have had a very closely interwoven existance with that of mankind. They have provided him with a source of amongst other things food, drink and rope; they have fed his cattle; they have helped him to build and then to protect his dwellings; they have helped to adorn his enviroment;they have provided him with the raw material for a wide ranging area of research and debate and for all of these things mankind should be grateful.

J.R.Kolendo (1996 ; revised 2002)

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